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SHOULD THE AIR FORCE TEACH RUNNING TECHNIQUE?

by

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Biography

Lieutenant Colonel Brent Johnson is the consultant to the Air Force Surgeon General for Podiatry and oversees recruitment, assignments, and career progression for the podiatry career field. After completing his residency training in foot and ankle surgery in Dearborn, Michigan, he entered the Air Force and served at Wilford Hall Medical Center (WHMC). LtCol Johnson was an instructor for multiple sessions of the Trauma Refresher Course for Surgeons at WHMC and Tuzla, Bosnia. While stationed at Landstuhl Regional Medical Center, Germany, he served as Medical Director of the Deployed Warrior Medical Management Center and was responsible for medical oversight of all patient transit from Operations Enduring Freedom and Iraqi Freedom. While assigned to the Air Force Research Laboratory, LtCol Johnson deployed to Guantanamo Bay, Cuba in support of Operation Enduring Freedom, and served as a researcher and as the executive officer for the AFRL commander. Prior to his assignment at the Air War College, LtCol Johnson served as Surgical Subspecialty Flight Commander, 673d Surgical Operations Squadron, Joint Base Elmendorf-Richardson, Alaska. During this assignment as flight commander, he maintained a full-time surgical practice and led 6 surgical specialty clinics at the Air Force/Veteran Affairs Joint Venture hospital in support of the Alaska Command region.

Abstract

Running is a valuable aerobic training activity and is used by all the American military branches for conditioning and measuring aerobic fitness. Despite the benefits of running, injury rates of 20-92% are reported in the medical literature. New concepts in running, consisting of minimalist shoes, barefoot running, and gait training techniques, have the potential to lower injury rates and make it more likely that running will be incorporated into a life-long fitness program. These modalities are reviewed and the current medical research is evaluated to determine the potential benefits of minimalist shoes, barefoot running, and gait training techniques. Current research indicates efficiencies in running with a forefoot or midfoot- strike gait, and a recent retrospective study showed a lower injury rate in forefoot-strike runners as compared with heel-strike runners. However, there are no definitive prospective studies demonstrating reduced injury rates at this time. Current evidence suggests reduced injury potential of these techniques and the author recommends a gait training program that can be adopted Air Force wide. An Air Force Efficient Running program could be implemented at low cost with the potential of significant injury rate reduction. This program would also provide the means to conduct large population-based studies that would better document potential injury reduction, add to the sports medicine literature, and potentially provide injury reduction across the Department of Defense.

Introduction

Running is a significant part of conditioning across the Department of Defense and is featured in basic training, advanced training, and physical fitness testing for all the military branches. Running has been an integral part of the current Air Force Physical Fitness Test since its inception in 2004, replacing cycle ergometry.¹ During this time, the other services have continued their emphasis on running in their physical fitness testing.

Although an important component in DoD conditioning, running is a high-impact form of exercise and reported running injury rates range from 20%- 92% in the medical literature.^{2 3 4} Reducing injuries would decrease lost training time and would encourage people to include running in their life-long fitness program. By staying active, sedentary-related health problems such as obesity and diabetes can be reduced.

There has been much interest in new “minimalist” shoe designs and running gait training programs. Early research, along with anecdotal accounts in running communities, suggests minimalist shoes and gait training can increase efficiency and lower injury rates. This paper will examine running injury rates, shoe design, and running gait training and effects. Most importantly, this paper will present recommendations for the incorporation of gait training in the Air Force. These recommendations are applicable across the Department of Defense and if proven effective could also be adopted by the other services.

Current Concepts

Current Air Force fitness testing policy is documented in Air Force Instruction 36-2905, *Fitness Program*, 1 July 2010,⁵ and Guidance Memorandum, 1 July 2011.⁶ The Air Force fitness test has four components: a 1.5 mile run (or 1.0 mile walk if medically unable to run), abdominal circumference, push-ups, and sit-ups. Scoring is adjusted based on sex and age criteria. If an Airman is under a medical profile that limits activity, he or she must still test allowed components and achieve a passing score.

There are very real consequences of physical fitness test failure that can include administrative action and eventual separation from the Air Force. If an Airman fails fitness testing, a retest must occur within 90 days. Commanders must initiate a retention or separation recommendation to the installation commander after an Airman has accumulated four unsatisfactory scores in a 24-month period and if the Airman has failed to demonstrate significant improvement. Running injuries or inefficient gait style can make passing the running component very difficult and can place the Airman in danger of failing the entire test.

Although a widely-popular activity, running has long been associated with injuries. In a retrospective survey of 725 marathon participants, Van Middlekoop found an injury rate in the previous year of 54.8%.⁷ Walter et al. followed a cohort of 1,680 runners for 12 months. 48% of these runners suffered an injury during the study; 54% of these injuries were new, and the others were recurrences of prior injuries. The investigators concluded that runners injured in the previous year had a 50% risk of sustaining a new injury during this study.⁸

Van Gent and associates surveyed 14 prospective and 3 retrospective cohort studies in the medical literature that documented lower extremity running injury rates ranging from 19.4-79.3% over time periods of 18 months or less. In other studies that also included non-lower

extremity injuries, this injury rate rose as high as 92.4%. Knee injuries were the most common, followed by lower leg, foot, and upper leg injuries. In their review, they found women were more prone to injury than men. Increased age was associated with increased injury risk in some studies, but appeared to be a protective factor in others.⁹

In their retrospective analysis of 2,002 running injuries, Taunton and colleagues found that patellofemoral pain syndrome remained the top injury, just as it was in another study at their institution 20 years earlier.¹⁰ Taunton et al. did not find an increased risk of subsequent injury; but in their prospective study of 824 female Marine Corps recruits at Parris Island, Rauh and associates found trainees that sustained a tibial stress fracture had a twofold increased risk of sustaining an additional stress fracture or other overuse injury.¹¹ Similar injury location and high injury rates (46%) were also reported by McKean, et al. in their 1-year retrospective survey of 2,886 runners.¹²

In addition to these well-documented running injury rates, additional impact is recognized in military populations, including lost training time, need to repeat basic or advanced skill training, possible separation, and increased recruiting costs.¹³ Running injuries are common among basic training populations, and lost time and medical costs related to these injuries can be very significant, although precise costs are difficult to calculate. The Air Force Surgeon General's office estimates that running injuries cost the Air Force 58 million dollars per year.¹⁴ Crowell et al. estimate costs for medical care and eventual separation due to running-related stress fractures alone costs the United States Army 6.2 million dollars annually.¹⁵

What can be done to lessen the impact of running injuries, or to reduce the injury rate? There has been much recent interest in running shoes, gait styles, barefoot running, and gait training in the popular media.^{16 17 18 19 20 21} Interestingly, the modern running shoe has only

existed since the 1970's when Nike began manufacturing running shoes with built-up heels that added cushioning. Prior to that, people ran in shoes that resemble racing flats and that closely mimic today's "minimalist" shoes. The newest trend in running shoes, minimalist shoes are lightweight, more flexible, and have a heel height-forefoot height difference that approaches 0 mm. This heel height to forefoot height ratio indicates a lack of an elevated, shock-absorbing heel. The combination of flexibility, lightness, and flat construction results in a shoe that allows the foot to function in a more natural, "barefoot-like" fashion and allows a forefoot or midfoot-strike gait, as opposed to the heel-strike gait style often seen with traditional running shoes. Research described throughout this paper indicates advantages to a forefoot-strike gait, and suggests that this gait style may produce lower initial impact forces and fewer injuries than a heel-strike gait.

Gait Contributions to Running Injuries

Daniel Lieberman and colleagues, academic anthropologists who had studied the human evolutionary record in terms of endurance running, investigated the topic of running gait so they could better understand how humans ran without shoes. They compared American and Kenyan runners who usually run without shoes with same-nationality subjects who traditionally run with shoes. They discovered that habitually-unshod runners used a forefoot-strike gait, while those who ran with shoes landed on their heels. The authors documented a high transient force spike among heel-strike runners that occurred when the foot hit the ground in front of the body. This high impact transient force, which travels up the body, can be 1.5-3 times bodyweight, and other researchers theorize this impact force could account for running injuries. Forefoot-strike runners displayed no impact transient and displayed half the rate of loading in shod runners. Barefoot runners had a plantarflexed ankle when making forefoot contact with the ground. Impact forces

were dispersed as the ankle dorsiflexed and the heel dropped to make ground contact, while the calf muscles contracted eccentrically. Vertical impact forces were converted into rotational kinetic energy, and combined with knee flexion and adjustment of leg stiffness, resulted in decreased rate of loading. Finally, Lieberman et al. theorized that runners wearing traditional running shoes with a thick heel impact the ground heel first, and that these shoes actually cause rearfoot-strike running.²²

While anthropologists noted impact force differences between shod and unshod runners that may help explain injury potential, other researchers have discovered possible links between gait and running injuries. Edwards and associates discovered somewhat counterintuitively that reducing preferred stride length by 10% decreased tibial stress fracture probability 3-6% in a test group of runners.²³ Likewise, Elliott and Blanksby discovered an increase in efficiency occurred with shortening stride length while running.²⁴ Shakoor and Block evaluated 75 subjects with knee osteoarthritis while walking shod and barefoot, and documented significantly decreased dynamic loads at the knee while walking barefoot, along with decreased stride length and increased stride frequency.²⁵ Hreljac reviewed the medical literature and pointed out that, although running injury causes are multifactorial, many injuries may be caused by impact during gait, and that increased tibial stress fracture risk has been linked with higher than normal impact forces.²⁶

Daoud and associates retrospectively compared injury rates of 36 heel-strike runners and 16 forefoot-strike runners from a single collegiate cross-country team. They discovered that the heel-strike runners had almost double the rate of repetitive injuries than the forefoot-strike runners. This study had some limitations due to small sample size, a highly competitive athletic population, and the retrospective nature of the study. While acknowledging that running injury

causes are multifactorial, the authors theorized that the reduced injury rate in forefoot-strike runners was due to the absence of the initial high-impact force found in a heel-strike gait; they pointed out this causality question for future research.²⁷

The research discussed in this section indicates that forefoot-strike runners may undergo a lower injury rate than heel-strike runners. Wearing shoes while running as compared with running barefoot may predispose runners to using a heel-strike gait which generates higher impact forces that may subject runners to injuries. Shortening stride length (which occurs with barefoot running and is also taught in gait training programs discussed later in this paper) also increases running efficiency and lowers risk of injury.

Shoe Contributions to Running Injuries

If traditional running shoes predispose to a heel-strike gait which causes increased impact forces and injury risk, it is worthwhile to explore research on the direct effect of shoes on foot biomechanics and gait. Robbins and Gouw detailed studies showing that running shoes allow impact forces that may exceed injury thresholds to be transmitted to the skeletal system.²⁸ They further detailed studies that showed subjects modified their running style and decreased impact forces when barefoot. Finally, they theorized that when the human foot is “insulated” in a running shoe and protected from cutaneous sensation normally available when barefoot, people do not perform those shock-attenuating changes to limit the amount of impact.²⁹ They recommended shoes that better allow sensory feedback and described an ideal shoe that sounds very much like today’s minimal running shoe. Kerrigan and associates noted significantly greater joint torques across the hip and knee while subjects ran in running shoes, as compared when they ran barefoot.³⁰ Morio et al. documented significant differences in forefoot-to-rearfoot motion in shod and unshod runners and concluded that running shoes constrain normal foot

motion.³¹ While the studies reviewed to this point do not prove a link to injury, there is evidence that shoes certainly negatively affect foot function, and runners who do not wear shoes run in a very different manner than shod runners. It follows that an optimal shoe for running would be light, flexible, fit well without being too tight, and allow the foot to function as close to a barefoot state as possible.

Since their introduction, traditional running shoes have become heavier, with thicker soles and increased cushioning to protect a supposedly-fragile lower extremity from impact forces while running. This is despite the fact that humans have been running for millions of years in more simple shoes and even barefoot. There is no evidence that increased shoe technology has impacted injury rates. Richards, Magin, and Callister noted that “pronation-control, elevated cushioned-heel running shoes have never been tested in controlled clinical trials. Their effect on running injury rates, enjoyment, performance, osteoarthritis risk, physical activity levels, and overall athlete health and well-being remain unknown. The prescription of this shoe type to distance runners is not evidence based.”³²

Consistent with this finding, U. S. Army Center for Health Promotion and Preventive Medicine reported on three large prospective studies examining basic trainees in the U. S. Army,³³ Air Force,³⁴ and Marine Corps.³⁵ These studies followed 7,180 recruits; control groups received a “stability” traditional running shoe (designed for a runner without biomechanical problems and a normal arch) regardless of foot structure, and the experimental group was prescribed motion-control, stability, or cushioned shoes of the same brand for low, medium, or high arches, respectively. Researchers discovered no injury difference between experimental and control groups and concluded that all trainees should be issued stability shoes for basic training.

Minimalist shoes have become popular with consumer demand for lighter, more flexible running shoes that closely mimic the barefoot experience. Minimalist shoes are similar to moccasins or racing flats; they are lightweight, have minimal heel height, have a flexible sole that allows the foot to move unconstrained, and have almost no cushioning. Squadrone and Gallozzi concluded in a comparison of traditional shod running, running with Vibram Five Fingers© shoes, and barefoot running, that runners wearing Vibram Five Fingers© displayed the same gait and biomechanics as barefoot running. They found that Vibram Five Fingers© allowed a similar experience to barefoot running while adding a small amount of protection.³⁶

Injuries are possible and might even be common initially with minimalist shoes. The greatest danger is the transition period from traditional running shoes to minimalist shoes. As discussed earlier, most runners in traditional shoes run with a heel-strike gait, and most barefoot runners run with a midfoot or forefoot-strike gait, because landing on the naked heel is painful and only possible with a thick cushioned running-shoe heel. Minimalist shoes typically have a very low heel and almost no difference in heel-forefoot height. This low heel combined with little heel cushioning causes a gait change to a forefoot or midfoot-strike gait. The calf muscles stretch a little more because of the low shoe heel and also contract at the same time to slow the heel lowering to the ground. This combination (along with the knee flexing) absorbs shock, but the low heel and increased calf muscle use result in calf and Achilles tendon soreness frequently described by runners switching to barefoot or minimalist shoes. Another common injury from switching too quickly to a forefoot-strike gait is metatarsal stress fracture.³⁷ Runners transitioning to minimalist shoes or barefoot running must be careful to slowly introduce the new method into their running regimen and rest if they develop any forefoot soreness. Some barefoot runners recommend learning to run barefoot first; they claim that sensory feedback from

impacting the ground while barefoot will help a runner perfect their gait³⁸. Barefoot running at first is limited to just a few minutes because too much running will result in blistering. The slow, gradual adaption of the plantar skin will give the skeletal system time to also gradually adapt. It may be that shoes such as the Vibram Five Finger© line provide just a bit too much protection; the inexperienced runner's foot is protected from shear forces on soft tissue which would soon cause blistering and limit the runner; the runner can now run too far, exposing his body to new demands from the new way that his foot is striking the ground that will eventually produce injury.

Injury can also be experienced by barefoot runners. Although they may function in a more natural way, barefoot runners are subject to all the injuries described above, plus small abrasions and puncture wounds from which shoes would normally protect them. These soft tissue wounds can be minimized by careful route selection and by scanning and avoiding debris, but there always is some risk. Opponents of barefoot running will claim that humans traditionally ran barefoot on natural surfaces and did not evolve to run on modern hard surfaces such as concrete and asphalt. However, as demonstrated by many barefoot runners, humans are actually quite capable of running barefoot on these surfaces. Surface hardness is not a limiting factor, but surface roughness definitely is. Concrete and asphalt can be very smooth, but the rougher the surface, the greater the discomfort. Additionally, environmental factors may result in surfaces which are too hot or too cold on which to run barefoot. So, even barefoot runners may find themselves needing shoe gear from time to time.

Some in the barefoot and minimalist running community take an extreme position by claiming that traditional running shoes cause injuries and minimalist shoes or barefoot runners have fewer injuries. There are many anecdotal claims by minimalist and barefoot runners of

their injuries resolving when they stopped using traditional running shoes. Discussed earlier in this essay is the research of Daoud et al. noting the increased injury rate of heel-strike runners.³⁹ However, there are no prospective clinical outcome studies comparing populations of traditional shoe heel-strikers with barefoot runners or those wearing minimalist shoes.

Gait Training Techniques

The gait training techniques described in this section build upon the concepts already described about foot strike, stride length, and shoes; they have become increasingly popular in the running community, with varying claims of injury reduction. Recent gait training styles include Pose running, Chi running, and Evolution running. Barefoot running, because it drives adoption of a midfoot- or forefoot-strike gait style, can also be grouped into this category. Lastly, recent research involving gait training with visual feedback has been shown to decrease impact forces. All of these will be discussed in this section.

The Pose gait training technique was developed by Nicholas Romanov, Ph.D., and focuses on the development of a running “pose,” which he describes as the head, shoulders, buttocks, and forefoot all in perfect vertical alignment. The optimal position of the foot at ground contact is directly under the body, touching down with the forefoot, and pulling the foot back off the ground almost at the same instant that it touches down. The hamstrings lift the foot from the ground, the body falls forward, and the foot is brought forward to make ground contact. He emphasizes the importance of not consciously striving to put the foot back on the ground (rather to simply allow gravity to make it happen) and not lifting or driving forward with the hips and knees.⁴⁰ In his book, *Pose Method of Running*, Romanov includes a chapter on barefoot running, discusses the problems caused by a cushioned, elevated-heel running shoe, and notes

that the process of barefoot running allows runners to naturally assume a Pose-style running form.⁴¹

The Chi Running technique, developed by Danny Dreyer, includes much of the same body positioning as the Pose method. Chi also emphasizes the importance of using gravity to fall forward, with the foot contacting the ground under the body and never in front of the body.⁴² Both Pose and Chi emphasize that when the foot contacts the ground ahead of the body, there is a braking effect on speed which creates more impact and stress to the body; when the foot lightly touches down under the body, the body's momentum easily allows it to travel over the foot without interference. Chi teaches a mid-arch strike, and Dreyer recommends lighter "training flats" without an elevated heel. Dreyer also discusses barefoot running and notes that "people who run barefoot have much better running form than people who wear shoes."⁴³ He further notes that running barefoot will force a runner to land on the mid-arch foot and force him or her to assume the other components of the Chi style.

Evolution Running, developed by Ken Mierke, is intended to increase efficiency and improve running form. Available on the DVD titled *Evolution Running*, it is geared toward competitive runners or those trying to increase race times, while the Pose and Chi methods are geared more to the fitness runner. Mierke mentions barefoot runners and their efficient running style. Evolution Running is built on much the same form as occurs with barefoot running and the previous methods. It emphasizes a shorter stride, once again with foot strike directly under the body, a forefoot strike, and upright posture.⁴⁴

The gait of runners without shoes is very similar to the gait training styles previously described in this section. Components of a barefoot gait are a forefoot or midfoot strike, foot

strike directly under the body, a rapid shorter stride, and an upright body with a slight forefoot lean.⁴⁵

The final form of gait training presented here is “visual feedback” training. Building upon research which showed improvement in running gait parameters using visual and verbal feedback among a group of female runners,⁴⁶ Crowell and associates attached accelerometers to the ankles of subjects who ran on instrumented treadmills, and displayed their peak positive tibial acceleration on video monitors. A line was placed on the display indicating 50% of each runner’s peak positive acceleration, and runners were told to “run softly” and keep their peak positive acceleration below the line. Four of 5 subjects displayed significant reductions in peak positive tibial acceleration, and all subjects showed significant decreases in impact peak and vertical ground reaction force loading rates.⁴⁷ Crowell and Davis then repeated this study with a one-month follow-up assessment. They observed that after initial training, subjects demonstrated approximately 50% decreased tibial acceleration, 30% decreased vertical force loading rates, and 20% decreased vertical force impact peak; these reductions were maintained at the one-month assessment.⁴⁸ Noting that other researchers had observed abnormally-high measurements of these forces in subjects who had sustained tibial stress fractures, they theorized that visual feedback gait training may provide risk reduction for future injury.⁴⁹

Gait Training- What Does the Evidence Show?

Of the research presented thus far, Crowell et al. make the best link between decreased impact forces from gait training and potential injury reduction. In a comparison of running styles, Arensde et al. tested runners initially using a heel-strike gait, then after telling them to land on the midfoot, and finally after they underwent a training program in Pose Running. They discovered that the Pose gait resulted in reduced stride length, less vertical motion, and lower eccentric work and power absorption at the knee than was observed with the other gait styles. Heel strike gait had the greatest magnitude and loading rate of vertical impact force.⁵⁰ In a survey of Chi running enthusiasts who either subscribed to a newsletter or had ordered instructional Chi running books or DVDs, Cucuzzella, Boys, and Hryvniak reported 93% of 3,500 respondents felt that Chi running played a role in injury prevention. 57% reported recovering from an injury and that Chi running was helpful in doing so. 73% felt their speed improved, and 94% felt improved ease of running.⁵¹ This data must be carefully interpreted since surveys can be biased by those choosing to respond; although interesting, these results point to a need for a more rigorous study.

In comparison to Pose, Chi, or Evolution running styles, there is much more research evaluating barefoot running. In addition to the work done by Lieberman discussed elsewhere, Divert and colleagues compared test subjects running both shod and barefoot. They documented higher stride frequency, lower vertical displacement, and higher mean vertical and leg stiffness when their subjects ran barefoot. They noted that their results supported others' conclusions that barefoot running was more efficient than shod running.⁵² In a separate study, Divert et al. also reported a decrease in efficiency among shod runners as compared with barefoot runners, and concluded the decreased efficiency was from the added weight of shoes and from gait changes.⁵³

Oxygen consumption is lower in barefoot runners,⁵⁴ and barefoot runners strike the ground with a flatter foot attitude to absorb shock and direct shock away from the poorly-cushioned heel⁵⁵ and to absorb impact through medial arch deflection.⁵⁶ During barefoot running, the leg swings forward and the ankle is plantarflexed before ground contact. The gastrocnemius soleus muscle complex undergoes a higher level of preactivation in barefoot running as it prepares to counter ankle dorsiflexion caused by forefoot or midfoot strike.⁵⁷ Meanwhile, the runner alters the stiffness of his or her leg to absorb shock and optimize leg stiffness in relation to the running surface and barefoot (or shod) status.⁵⁸ It has also been observed that wear of minimalist shoes compared to traditional shoes increases muscle strength of extrinsic and intrinsic foot muscles due to increased functional demands,⁵⁹ which indirectly confirms anecdotal observations of runners that their foot muscles adapt and strengthen to support barefoot running. Excellent review articles by Jenkins and Cauthon⁶⁰ and by Warburton⁶¹ provide additional summaries of research.

Current Air Force Gait Training

Despite the increased focus on physical fitness and its importance to an Airman's career, there is no Air Force standardized approach to gait training.⁶² Some attempts at gait training have been provided at local levels by interested providers or Health and Wellness Center (HAWC) staff.

There is currently an initiative to develop a gait training program across the Air Force. Lt Col Mark Cucuzzella, M.D. (Professor of Family Medicine at West Virginia University and Air Force Reservist) and Lt Col Antonio Eppolito, M.D. (Chief, USAF Telehealth, Air Force Medical Support Agency) have taught a series of workshops at the Air Force Marathon and at several bases and report excellent feedback from participants.⁶³ In light of the 58 million dollars

that running related injuries cost the Air Force each year, a budgeting request for \$150,000 has been submitted to fund development of a gait training program across the Air Force. Although an injury reduction up to 50% (and an annual savings of 29 million dollars) is possible, the program only needs a 0.6% reduction in running injuries to pay for itself. Assuming that the program does lead to a 50% reduction rate, the program will pay for itself in the first 3 days of operation.⁶⁴

Recommendations

As presented in this paper, laboratory research on forefoot/midfoot-strike gait, barefoot running, and gait training suggests that these techniques may result in lower injury rates and greater efficiency than traditional running shoes and heel-strike gait. Prospective comparison studies between forefoot-strikers and heel-strikers similar to that performed by Daoud and associates will provide additional insight on injury rates. As was noted by Daoud et al., their subjects had not undergone gait training to change their gait to a forefoot-strike pattern; whether heel-strike runners converting their gait would enjoy a similarly reduced rate of injury is another area for study.⁶⁵

The information reviewed in this paper supports an Air Force- wide gait training program, given the low program cost, high potential benefits, and current running injury rate. It would also help educate Airmen already adopting minimalist shoes and gait programs and to minimize injuries as they transition away from traditional running shoes. This Air Force Efficient Running program could also help increase running efficiency for those failing the run portion of the PT test and patients with a gait-related running injury.

This program would not be targeted at everyone. Changing one's running style is a process that takes weeks or months and requires self-motivation. If a runner is satisfied with his

or her running program and shoes, there is no immediate reason to change. Air Force runners failing the run portion of the fitness test may benefit from the concepts, but since they are on a limited timeline to show improvement, a wholesale change in their running style may be best done after they have improved enough to pass. Likewise, those with an upcoming fitness test or athletes training for an upcoming race also may wish to wait. A very good target population would be runners recovering from an overuse injury, as having sustained a past injury seems to make runners more prone to future injury.⁶⁶ The average fitness runner may also benefit from gait training. This training program should be publicized at the HAWC, Fitness Center, and Medical Groups.

Pose, Chi, and Evolution techniques are similar, and all three are very similar to barefoot running. An Air Force gait training program should teach the common components with the warning that changes must be slowly incorporated into a running program to avoid injuries during the transition. These techniques can be adopted without the need to change running shoes, so a runner has the option to use his or her previous shoes, adopt a minimalist shoe, or convert to barefoot running. It must be emphasized that the greater the shoe gear change, the greater the time needed to slowly adapt to the new style. Finally, it should be made clear that although evidence points to increased efficiency and reduced injuries with this running style, additional research is needed.

This training program would best be accomplished by designing a computer-based or multimedia training program, with local HAWC or Fitness Center personnel assisting in a classroom format. At an absolute minimum, the *Evolution Running* DVD could be made available for loan at either the Fitness Center or HAWC. This DVD presented the concepts and theories more effectively than any of the other gait systems the author reviewed.

Conclusion

This treatise reviewed running and its place in the Air Force fitness test, running injury rates, running styles of traditionally unshod runners compared to those wearing traditional running shoes, and the impact of minimalist running shoes. Also explored was the possible relationship between traditional running shoes and their effect in promoting a heel-strike gait, which causes an impact force spike far exceeding that of barefoot runners using a forefoot-strike gait, possibly contributing to running injuries. Finally, gait training styles were reviewed and similar components were identified, research on these styles was reviewed, and recommendations made for an Air Force-level gait training program.

Current research indicates benefits and efficiencies in the use of these modalities and of running with a forefoot- or midfoot- strike gait; prospective outcome studies comparing injury rates have not yet been published. Given the low cost of a gait training program and the high potential savings, the author recommends adoption of an Air Force Efficient Running program to train interested Airmen with the goal of injury reduction. Once deployed across the Air Force, it can be used to train runners for a long-term, multi-location, clinical outcome study. A population of trained runners can then be compared to untrained runners using a heel-strike gait to evaluate injury rates. If injury reduction is documented, then the program could be made available across the Department of Defense. Injury reduction, increased running enjoyment, and a fitter active-duty force and healthier retiree population could be the benefits of an Air Force Efficient Running program.

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